



RADIATION PROTECTION STANDARDS AND GUIDES AT GOODYEAR ATOMIC

CONTENTS

A. C. 100-100

Industrial Hygiene and Health Physics Department

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GOODYEAR ATOMIC CORPORATION

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PREFACE

The intent of this document is four-fold:

1. To document Goodyear Atomic Corporation's compliance with the "Report of UCCND-GAT Committee on Radiation Standards and Practices for Gaseous Diffusion Plants," 1981 (referred to internally as the "Three Plant Document").
2. To state new guidance in the areas of skin contamination, medical x-ray exposures and leak testing requirements.
3. To incorporate CY-1984 revisions of existing GAT radiation protection documents.
4. To provide radiation protection guidance to Health Physics staff and surveyors in a formal, concise format.

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DOSE LIMITS

	<u>Time Period</u>	<u>DOE (Rem)</u>	<u>PAL (Rem)</u>
I. Radiation Worker			
A. Whole body, head, trunk, gonads, red bone marrow, lens of eye	Year 13 wks.	5.0 3.0	5.0 1.25
B. Hands	Year 13 wks	75.0 25.0	75.0 18.75
C. Bone	Year 13 wks	30.0 10.0	30.0 10.0
D. Other organs and skin	Year 13 wks	15.0 5.0	15.0 3.75
II. Pregnant Worker	9 mos.	0.5 ^a	0.5
III. Member of General Public	Year	0.5	0.5

^aRecommended Level

GAT CONTAMINATION LIMITS^a FOR ORGAN BURDEN

<u>Material</u>	<u>Organ Burden Limit</u>
Uranium (U)	
Insoluble U in the lungs	0.017 microcuries or (240 micrograms U-235) ^b
Soluble U in the bones	0.045 microcuries or 100,000 dpm
Technetium-99 (Tc-99)	
Insoluble Tc-99 in the lungs	9 microcuries or 20 million dpm
Soluble Tc-99 in the GI tract	2.5 microcuries or 5.5 million dpm

^aThe limits are provided in different units because personnel monitoring is reported in various units.

^bThe maximum allowable lung burden for uranium (when reported in micrograms of uranium-235) is dependent upon the assay. This value ranges from 240 to 330 micrograms U-235.

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MAXIMUM PERMISSIBLE ORGAN BURDENS FOR URANIUM VERSUS ENRICHMENT

<u>ENRICHMENT</u>	<u>MILLIGRAMS</u>		
	<u>LUNG</u>	<u>BONE</u>	<u>KIDNEY*</u>
0.7	29.257	86.050	8.605
5	6.190	18.210	1.821
10	3.035	8.926	0.893
15	2.133	6.274	0.627
20	1.617	4.756	0.475
25	1.294	3.810	0.381
30	1.180	3.470	0.347
35	1.025	3.015	0.301
40	0.885	2.603	0.260
45	0.792	2.330	0.233
50	0.708	2.082	0.208
55	0.643	1.891	0.189
60	0.587	1.732	0.173
65	0.532	1.565	0.156
70	0.479	1.409	0.141
75	0.432	1.271	0.127
80	0.383	1.126	0.113
85	0.346	1.018	0.102
90	0.298	0.876	0.088
95	0.232	0.682	0.068

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*These organ burdens are based on radiological toxicity.

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DECISION LEVELSI. EXTERNAL EXPOSURE

<u>Type of Exposure</u>	<u>Flag</u>	<u>Derived Levels (rem)</u>	
		<u>Investigate</u>	<u>Restrict</u>
Whole Body	0.3/qtr	0.5/qtr	1/qtr (4/yr)
Skin	0.5/qtr	0.75/qtr	1.5/qtr (6/yr)

II. INTERNAL EXPOSUREA. URINALYSIS

<u>Type of Analysis</u>	<u>Flag</u>	<u>Derived Levels (dpm/100ml)</u>	
		<u>Investigate</u>	<u>Restrict</u>
Routine Uranium Alpha	8	16	80
Special Uranium Alpha	800	1,200	2,000
Routine Technetium Beta	5,000	20,000	60,000
Special Technetium Beta	100,000	200,000	500,000

B. IN-VIVO

<u>Isotope</u>	<u>Derived Levels</u>	
	<u>Investigate*</u>	<u>Restrict</u> ¹
U-235 (ug)	100	240
U-238 (mg)	4	27
Tc-99 (uCi)	1	9

* On recall count

¹ Assay and solubility classification (T 1/2 effective -- determined by least-squares analysis) will be considered in actual restriction cases.

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GAT LIMITS FOR CONTAMINATION LEVELS

<u>Item</u>	<u>Contamination Type</u>	<u>Alpha Activity (dpm per 100 cm²)</u>	<u>Beta Activity (dpm per 100 cm²)</u>
Clean Floors	Surface Removable	1,000 200	25,000 5,000
Clothing			
1) Company-issued coveralls, gloves, etc.	N/A	1,000	200,000
2) Company-issued shoes	N/A	10,000	400,000
3) Personal clothing	N/A	200	9,000
Body Contamination	N/A	200	3,000
Hand Tools and Other Equipment	Surface Removable	1,000 200	25,000 3,000
Process Shop and PG Equipment	Surface Removable	5,000 1,000	200,000 3,000
Respiratory Equipment			
1) Inside*	Surface Removable	<detectable <detectable	<detectable <detectable
2) Outside	Surface Removable	1,000 200	25,000 3,000
White Tag			
1) Off-plantsite shipment & surplus & salvage	Avg. Surf. Max. Surf. Removable	5,000 15,000 200	5,000 15,000 1,000
2) On-plantsite equipment to be reworked	Surface Removable	5,000 1,000	200,000 3,000
Green Tag	Surface Removable	30,000 2,000	2 million 30,000

The Ludlum Pancake detector is 12.5% efficient for beta counting.

The Ludlum Alpha Scintillation detector is 50% efficient for alpha counting.

*Contamination survey using Ludlum Pancake and Alpha Scintillation detectors.

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Contamination¹ and Penetrating Radiation Tagging Limits

Item	White Tag*		Green Tag*		Pink Tag [@]		Yellow Tag (Pen. Radiation)
	Alpha	Beta	Alpha	Beta	Alpha	Beta	
Hand Tools and non-PG Equipment	S 1,000	25,000	30,000	2 Million	>30,000	>2 Million	<u>mR</u> 2.5 hr
	R 200	3,000	2,000	30,000	> 2,000	>30,000	
Process Shop and PG Equipment	S 5,000	200,000	30,000	2 Million	>30,000	>2 Million	<u>mR</u> 2.5 hr
	R 1,000	3,000	2,000	30,000	> 2,000	>30,000	
Respiratory Equipment (outside)	S 1,000	25,000	30,000	2 Million	>30,000	>2 Million	<u>mR</u> 2.5 hr
	R 200	3,000	2,000	30,000	> 2,000	>30,000	

¹ All contamination limits are in dpm/100 cm² units

* Maximum Limit.

R = Removable

S = Surface

[@] = Removable levels kept below 2000 dpm/100 cm² to avoid tagging where possible.

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SKIN CONTAMINATION GUIDE VALUES

	Alpha dpm/100 cm ² *	Beta dpm/100 cm ² *	Required Action:
Plant Allowable Limit	200	3000	If PAL is exceeded, decontaminate per established procedure. The patient may be released per established procedure if decontamination efforts are unsuccessful in reducing the contamination level below PAL as long as the alert level is not exceeded.
Alert Level	5,000	50,000	If this level is exceeded, decontaminate per established procedure, contact a physician or an IHHP Staff member if contamination cannot be reduced below these levels following routine decontamination attempts.

*dpm/probe area for hand contamination, or body contamination covering areas less than 100 cm².

If contaminated area exceeds 100 cm², sum results to obtain total activity per 100 cm², to accomplish this, sum 6 Pancake readings for beta activity or 2 alpha scintillation readings for alpha activity.

If contaminated area exceeds 500 cm², contact a physician or an IHHP Staff member.

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NONWORK SURFACE CONTAMINATION GUIDES AND CONTAMINATION ALERT VALUES FOR URANIUM

<u>ZONE</u>	<u>GUIDES</u>	<u>ALERT VALUES</u>
Contamination Control Zone	50,000 a dpm/100 cm ² smear, * average	5,000 a dpm/100 cm ² smear, * average
Regulated Zone	5,000 a dpm/100 cm ² smear, average	1,000 a dpm/100 cm ² smear, average
All Other Zones	1,000 a dpm/100 cm ² smear	200 a dpm/100 cm ² smear

*If direct measurements are made of uranium alpha contamination, the guides and the alert values should be increased by a factor of five, since 20 percent is the generally accepted fraction of directly measured contamination which has been found to be transferable.

Alpha dpm is determined by alpha radiation survey meter calibration with plated uranium alpha radiation standards.

LEAK TEST LIMITS FOR GAT-OWNED RADIOACTIVE SOURCES

<u>ISOTOPE</u>	<u>MAXIMUM LEAK TEST RESULT</u>
Ra-226	1×10^{-3} microcuries
Alpha Emitting Isotopes Other Than Ra-226	5×10^{-4} microcuries
Beta Emitting Isotopes	5×10^{-3} microcuries

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MEDICAL X-RAY EXPOSURE LIMITS AT GAT

Projection	ESEG (milliroentgens)
Chest (P/A)	30
Skull (Lat)	300
Abdomen (A/P)	750
Cervical Spine (A/P)	250
Thoracic Spine (A/P)	900
Full Spine (A/P)	300
Lumbo-Sacral Spine (A/P)	1000
Retrograde Pyelogram (A/P)	900
Feet (D/P)	270

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ALPHA RADIATION
RESPIRATORY EQUIPMENT GUIDE

I. Destruction of Surface:

A. Based on Surface Reading

<u>Range dpm/100 cm²</u>	<u>Equipment</u>
0 < x < 5,000	None
5,000 < x < 124,000	Half Face
124,000 < x < 620,000	Full Face
620,000 < x < 24,000,000	Airline
24,000,000 < x < 124,000,000	PD-SCBA
124,000,000 < x	No Work

B. Based on Wipe Reading

<u>Range dpm/100 cm²</u>	<u>Equipment</u>
0 < x < 1,000	None
1,000 < x < 40,000	Half Face
40,000 < x < 200,000	Full Face
200,000 < x < 8,000,000	Airline
8,000,000 < x < 40,000,000	PD-SCBA
40,000,000 < x	No work

C. Based on Both Surface and Wipe: Use more restrictive.

II. Non-Dispersible Material

A. Airborne Potential High: Wipe Survey

<u>1) Equipment Range (dpm/100 cm²)</u>	<u>Equipment</u>
0 < x < 3,000	None
3,000 < x < 40,000	Half Face
40,000 < x < 200,000	Full Face
200,000 < x < 8,000,000	Airline
8,000,000 < x < 40,000,000	PD-SCBA
40,000,000 < x	No work

<u>2) Floor Range (dpm/100 cm²)</u>	<u>Equipment</u>
0 < x < 10,000	None
10,000 < x < 132,000	Half Face
132,000 < x < 660,000	Full Face
660,000 < x < 26,000,000	Airline
26,000,000 < x < 132,000,000	PD-SCBA
132,000,000 < x	No Work

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B. Airborne Potential Low: Wipe Survey

<u>1) Equipment Range (dpm/100 cm²)</u>	<u>Equipment</u>
0 < x < 15,000	None
15,000 < x < 200,000	Half Face
200,000 < x < 1,000,000	Full Face
1,000,000 < x < 40,000,000	Airline
40,000,000 < x < 200,000,000	PD-SCBA
200,000,000 < x	No work
<u>2) Floor Range (dpm/100 cm²)</u>	<u>Equipment</u>
0 < x < 50,000	None
50,000 < x < 660,000	Half Face
660,000 < x < 3,200,000	Full Face
3,200,000 < x < 132,000,000	Airline
132,000,000 < x < 660,000,000	PD-SCBA
660,000,000 < x	No Work

III. Readily Dispersible or Unknown Material

A. Airborne Potential High

<u>1) Equipment Range (dpm/100 cm²)</u>	<u>Equipment</u>
0 < x < 1,000	None
1,000 < x < 13,200	Half Face
13,200 < x < 66,000	Full Face
66,000 < x < 2,600,000	Airline
2,600,000 < x < 13,200,000	PD-SCBA
13,200,000 < x	No work
<u>2) Floor Range (dpm/100 cm²)</u>	<u>Equipment</u>
0 < x < 2,000	None
2,000 < x < 26,000	Half Face
26,000 < x < 132,000	Full Face
132,000 < x < 5,200,000	Airline
5,200,000 < x < 26,000,000	PD-SCBA
26,000,000 < x	No Work

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B. Airborne Potential Low

1) Equipment Range (dpm/100 cm²)

0 < x <	3,000
3,000 < x <	40,000
40,000 < x <	200,000
200,000 < x <	8,000,000
8,000,000 < x <	40,000,000
40,000,000 < x	

Equipment

None
 Half Face
 Full Face
 Airline
 PD-SCBA
 No work

2) Floor Range (dpm/100 cm²)

0 < x <	10,000
10,000 < x <	132,000
132,000 < x <	660,000
660,000 < x <	26,000,000
26,000,000 < x <	132,000,000
132,000,000 < x	

Equipment

None
 Half Face
 Full Face
 Airline
 PD-SCBA
 No Work

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RESPIRATOR GUIDELINE BASED ON WIPE
CONTAMINATION RANGES FOR TECHNETIUM
AND URANIUM DAUGHTER BETA EMITTERS

Airborne Probability	$\frac{\text{dpm}}{100 \text{ cm}^2}$	0-40,000	40,000-100,000	100,000-400,000	400,000-600,000
Low	Non-Readily Dispersible	None	None	None	None
	Readily Dispersible	None	None	Half-face	Half-face
High	Non-Readily Dispersible	None	None	Half-face	Half-face
	Readily Dispersible	None	Half-face	Half-face	Full-face
Destruction of Surface		None	Half-face	Half-face	Half-face

Airborne Probability	$\frac{\text{dpm}}{100 \text{ cm}^2}$	600,000- 1,000,000	1,000,000- 10,000,000	10,000,000- 30,000,000	30,000,000
Low	Non-Readily Dispersible	Half-face	Half-face	Half-face	Contact IHHP
	Readily Dispersible	Half-face	Full-face	Full-face	Contact IHHP
High	Non-Readily Dispersible	Full-face	Full-face	Full-face	Contact IHHP
	Readily Dispersible	Full-face	Full-face	Contact IHHP	Contact IHHP
Destruction of Surface		Half-face	Full-face	Contact IHHP	Contact IHHP

SURFACE LIMIT = WIPE LIMIT X 5

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Airborne Probability: High airborne probability refers to any job activity which tends to significantly alter normal air currents to such a degree that removable contamination can be redispersed into the air resulting in an inhalation hazard; such job activities include, but are not limited to, sweeping, removing housing and using pneumatic tools. Low airborne probability refers to any job activity which does not greatly alter normal air currents such as, but not limited to, turning valves, wet decontamination, handling, motor aligning, and using hand tools, reading gauges, etc. Jobs which do not encourage resuspension of radioactive contamination may be performed without the use of respirators.

Dispersibility of Material: Readily dispersible material refers to any material whose physical and/or chemical state increases the probability of resuspension by disturbing normal air currents due to its light and/or powdery nature (light particles). Examples of highly dispersible material are post-release material, dust, oxide, floor sweepings, etc.

Destruction of Surface: Destruction of Surface refers to any task which will alter the physical state of contaminant or equipment such as, but not limited to, burning, drilling, cutting, heating, welding, grinding, burnishing, machining.

CONTAMINATION LIMITS FOR AIRBORNE CONCENTRATIONS

<u>SOURCE</u>	<u>LIMIT (dpm/ft³)</u>	
	<u>URANIUM</u>	<u>TECHNETIUM</u>
DOE limit for soluble material — based on toxicological properties for uranium	4	125,000
DOE limit for insoluble material	6	3,800
GAT's Plant Allowable Limit	3	1,900

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